Electronics/Computers

Fuel Cells Utilizing Oxygen From Air at Low Pressures

Power-to-weight ratios would be higher than in prior fuel cells.

John H. Glenn Research Center, Cleveland, Ohio

A fuel cell stack has been developed to supply power for a high-altitude aircraft with a minimum of air handling. The fuel cell is capable of utilizing oxygen from ambient air at low pressure with no need for compression. For such an application, it is advantageous to take oxygen from the air (in contradistinction to carrying a supply of oxygen onboard), but it is a challenging problem to design a fuel-cell stack of reasonable weight that can generate sufficient power while operating at reduced pressures.

The present fuel-cell design is a response to this challenge. The design features a novel bipolar plate structure in combination with a gas-diffusion structure based on a conductive metal core and a carbon gas-diffusion matrix. This combination makes it possible for the flow fields in the stack to have a large open fraction (ratio between open volume and total volume) to permit large volumes of air to flow through with exceptionally low backpressure. Operations at reduced pressure require a corresponding increase in the volume of air that must be handled to deliver the same number of moles of oxygen to the anodes. Moreover, the increase in the open fraction, relative to that of a comparable prior fuel-cell design, reduces the mass of the stack.

The fuel cell has been demonstrated to operate at a power density as high as 105 W/cm^2 at an air pressure as low as 2 psia (absolute pressure ≈14 kPa), which is the atmospheric pressure at an altitude of about 50,000 ft (≈15.2 km). The improvements in the design of this fuel cell could be incorporated into designs of other fuel cells to make them lighter in weight and effective at altitudes higher than those of prior designs. Potential commercial applications for these improvements include most applications now under consideration for fuel cells.

This work was done by Alan Cisar, Chris Boyer, and Charles Greenwald of Lynntech, Inc., for **Glenn Research Center**.

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Commercial Technology Office, Attn: Steve Fedor, Mail Stop 4-8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-17284-1.

Hybrid Ion-Detector/Data-Acquisition System for a TOF-MS

John F. Kennedy Space Center, Florida

A modified ion-detector/data-acquisition system has been devised to increase the dynamic range of a time-of-flight mass spectrometer (TOF-MS) that, previously, included a microchannel-plate detector and a data-acquisition system based on counting pulses and time-tagging them by use of a time-to-digital converter (TDC). The dynamic range of the TOF-MS was limited by saturation of the microchannel-plate detector, which can handle no more than a few million counts per second. The modified system includes (1) a combined microchannel plate/discrete ion multiplier and (2) a hybrid data-acquisition system that simultaneously performs analog current or voltage measurements and multianode single-ion-pulse-counting time-of-flight measurements to extend the dynamic range of a TDC into the regime in which a mass peak comprises multiple ions arriving simultaneously at the detector. The multianode data are used to determine, in real time, whether the detector is saturated. When saturation is detected, the data-acquisition system selectively enables circuitry that simultaneously determines the ion-peak intensity by measuring the time profile of the analog current or voltage detector-output signal.

This work was done by William D. Burton, Jr.; J. Albert Schultz; Valentine Vaughn; Michael McCully; Steven Ulrich; and Thomas F. Egan of Ionwerks, Inc., for **Kennedy Space Center**.

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:

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Refer to KSC-12619, volume and number of this NASA Tech Briefs *issue, and the page number.*

Spontaneous-Desorption Ionizer for a TOF-MS

John F. Kennedy Space Center, Florida

A time-of-flight mass spectrometer (TOF-MS) like the one mentioned in the immediately preceding article has been retrofitted with an ionizer based on a surface spontaneous-desorption process. This ionizer includes an electron multiplier in the form of a microchannel plate (MCP). Relative to an ionizer based on a hot-filament electron source, this ionizer offers advantages of less power consumption and greater mechanical ruggedness. The current density and stability characteristics of the electron emission of this ionizer are similar to those of a